FLUOROSCOPY OF THE GASTRO-INTESTINAL TRACT.

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Fluoroscopy was one of the earliest practical applications of the *x*-rays. However, the value of permanent radiographs in surgical diagnosis, together with a large number of burns of patients and operators in the early fluoroscopic examinations, has been responsible for sufficient adverse criticism to dampen fluoroscopic enthusiasm. The pioneer *x*-ray operators in Europe and America bear permanent scars that testify to the dangers of unprotected fluoroscopy, but the knowledge regarding the irritative possibilities that has been gained through calamities to pioneer Röntgenologists will serve to dispel this fear and establish fluoroscopy in the widening horizon. When we look upon the martyrs of Röntgenology we become reassured, for it is only the pre-protection period Röntgenologist or careless experimenter who has furnished us object-lessons. We have yet to note injurious *x*-ray effects upon the Röntgenologist who has worked with lead screen and protected tubes. We cannot, up to the present day, estimate the ultimate effect of the hard, penetrating portion of the radiations from an *x*-ray tube. We do know the results of continuous or interrupted exposure to the soft rays, and are able to guard against them. In no new departure of medicine and surgery have there been so many to enter upon its pursuit with such meager knowledge of its possibilities and dangers. This not only resulted in harm to these neophytes, but has also acted as a hindrance to the propagation of exact Röntgen knowledge. There has been, and probably still is, much *x*-ray work which is carried on with carelessness and ignorance. The scientific application of the *x*-rays suffers accordingly. The suggestion is then in order that such legislative action be taken as may preclude the use of the *x*-rays in other than skilled hands. This would mean elimination of the manufacturer, electrician, photographer, and others without medical training from a field where only exact knowledge and careful application will eliminate ill-effects.

The gigantic possibilities of fluoroscopy make it important for us to pursue its study only with such protected apparatus that no ill-effects may ever be reported. Constant use of and familiarity with fluoroscopic technique may lead one to a carelessness against which the Röntgenologist must conscientiously labor. This admonition is likewise applicable to all manner of *x*-ray application.

A review of the fluoroscopic situation indicates that the American has attempted to promote radiographic technique that would obtain the diagnostic information upon a succession of negatives which the fluoroscope reveals at a glance. There is only one radiographic technique up to the present time that can approach ordinary fluoroscopy; we refer to the Bio-röntgenography of Rosenthal, Rieder, and Kaestle, that Röntgen triumvirate of Munich. The expense of this latter method places it without the realm of practical usefulness.

While the American has been venturing his rapid radiography, the European of France and Germany has been perfecting a fluoroscopic technique that avoids by ample protection the inherent dangers peculiar to the *x*-rays. The original fluoroscopic device of the Guilleminot type, with inefficient protection, followed by the cumbersome protected apparatus of the Albers-Schoenberg type, are giving way to the convenient Béclère type. The new Dessauer kliniscop has some advantages over the Béclère. These latter types of fluoroscopic apparatus have the tube in an amply protected, freely movable, *x*-ray- and light-proof box, the adjustments of which permit all manipulations of tube and diaphragm by one hand. The lead-glass covered fluorescent screen is adjustable, allowing the patient to be placed either sitting or standing between the screen and the tube box. The Dessauer kliniscop has the advantage of permitting examinations in the recumbent position also, similar to the trockoscop of Haenisch or Holzknecht.

The advantages of fluoroscopy cannot be gainsaid. Radiographic substitutes cannot, in any succession of radiographs, give the diagnostic information that the fluoroscope supplies, without the expense and tedious process of negative development. The inexpensiveness and immediate usefulness of fluoroscopic facts are incontrovertible arguments. The possible dangers can be guarded against by proper protection of patient and operator.

The peculiar superiority of fluoroscopy over radiography depends in the ability to study the peristalsis and surgical anatomy of the alimentary tract. We may study the physiological or pathological conditions which influence the position and relations of the esophagus, stomach, and intestines, with reference to the adjacent organs and bony skeleton; the anchorage of stomach and intestines, either normal or influenced by adhesions; the disposal of food in the gastro-intestinal tract; pathological filling defects and abnormalities of contour as presented by alterations in the tissues or interference with muscular function of the gastro-intestinal tract.

The fluoroscopy of the gastro-intestinal tract requires modern protected apparatus. It must be used in a totally dark room that will permit the inspection of the leaded glass fluorescent screen without shading the screen. The bellows type of fluoroscope is not useful in the least; it leads to incorrect estimates of shadow values and is wofully inexact. It would be splendid if the bellows fluoroscope were eliminated entirely. It is responsible for so many ill-effects and adverse criticisms that we would delight in a bonfire of those now on earth and ostracise the manufacturer of any duplicates.

The author's technique of fluoroscopy consists in the use of the Béclère type of apparatus in a totally dark room. The current to the tube is controlled by a floor switch in the primary circuit, which is opened or closed by the foot of the operator. The tube is regulated by a weighted string which operates an adjustment upon the regulating bulb of the tube and is at the right hand of the operator. With the water-cooled tube, regulation is seldom required. We employ a continuous current of water in the tube, after a fashion seen at the Albers-Schoenberg-Haenisch Institute at Hamburg. This consists of a 2-gallon bottle, with a small rubber tubing attached to an outlet in lower segment. This bottle is placed about two feet above the tube. After circulating in the water-cooling compartment of the tube, the water runs off through a second tube to a container upon the floor.

Into the frame of the lead-glass covered fluorescent screen is fitted with thumb screws a piece of plain glass, upon which may be charted the outlines of the bismuth-filled organs and the anatomical landmarks, with blue and red fat-pencils. These charting glasses are readily changed and their markings may be copied later upon thin paper for record. It is poor policy to chart upon the lead-glass of the fluorescent screen, as one will not have time to copy and erase the sketches.

The patient is prepared for the examination by a fast of four to six hours; the removal of the clothing to the hips; metallic markers are placed upon the ensiform and umbilicus; the patient may either stand erect or sit upon a movable bicycle seat, between the movable tube box and the screen.

For the examination there are required bismuth capsules of varying sizes; paste of bismuth, sugar of milk, and water; bismuth in water, and bismuth porridge. We use a fairly thick porridge of cream of wheat, into which 40 to 60 grams of bismuth oxychloride or carbonate is thoroughly mixed. This is the established Riedersche Mahlzeit, when flavored with raspberry syrup. We prepare this in a chafing dish at the office or in the kitchen at the hospital.

The scheme of Holzknecht for gastro-intestinal fluoroscopy, as outlined in his monograph[1] may be simplified as follows: The patient is placed in the right anterior oblique position, and offered the small bismuth capsule. When the current is applied he is instructed to swallow. The route and rate of the capsule in the esophagus is noted until it reaches and passes through the cardiac orifice of the stomach. The succeeding larger types of the capsules are then offered and their course noted. By this means we are able to determine the location and lumen of an esophageal stricture. The capsules do not always find the orifice of a diverticulum; therefore we employ the bismuth paste, about a level teaspoonful of bismuth carbonate and sac. lac., half and half. This is swallowed at the suggestion of the operator and after the *x*-ray is turned on. The use of bismuth and water (2 drams of bismuth to 2 or 3 ounces of water) is then employed. By carefully noting the passage of the paste and the water mixture one can determine the pressure of esophageal strictures, diverticula, abnormalities due to adhesions, cardiospasm, dilatations, pleuritic tugs, esophageobronchial fistulæ, carcinomatous filling defects and alterations of outline, pressure of aneurysms or tumors upon the esophagus. The description of the fluoroscopic symptomatology of each of these conditions is worthy of a distinct and separate descriptive paper.

Personally, we feel that the role of fluoroscopy in gastric diagnosis is most alluring and satisfying. While certain diagnostic phenomena may be obtained from the inspection of a mixture of bismuth and water immediately after its ingestion, one should depend rather upon the Riederische Mahlzeit immediately following its ingestion. The phenomena of interest brought out by the water and bismuth are, briefly, as follows: The disposition of the mixture by the stomach—whether it immediately reaches the caudal pole and pylorus; if it does reach the pylorus, does some of it enter the duodenum before the reflex closure of the pylorus is provoked by the ingestion of food into the stomach. Upon this point rests the estimation of a patulous pylorus. Because the bismuth and water does not enter the duodenum at once, one should not assume that there is a stenosis of the pylorus, as the pyloric reflex may have been occasioned by the esophageal reflex.

Succeeding the fluoroscopy of the esophagus and stomach by these simple measures we instruct the patient to eat slowly the ten or twelve ounces of bismuth porridge. This may take some time, as we frequently find gastric patients unused to such food.

To simplify and curtail this paper, we shall list the fluoroscopic symptoms of the more common gastric conditions in which this method offers such valuable diagnostic assistance:

FLUOROSCOPIC SYMPTOMS.

I. PYLORIC STENOSIS. (1) Dilatation of the stomach, both longitudinally and transversely. (2) Antiperistaltic waves running from the pylorus to the greater curvature. (3) Interference with the emptying of the stomach, the exit of the food being delayed eighteen to forty-eight hours. Suspicious symptoms which should be noted are: More or less degree of distention of the stomach; weakened peristalsis; food delayed in exit twelve to twenty-four hours; adhesions of the pyloric area, which produce a fixed pylorus; pyloric filling defects; absence of any peristalsis at the pylorus, the wave running only from the greater curvature to the prepyloric area. The pyloric stenosis, whether produced by infiltrations and cicatrices about an ulcer or carcinoma, would produce almost identical symptoms. The differentiation can be determined by the stomach analysis, case history, and subjective symptoms.

II. GASTRIC CARCINOMA. Gastric carcinoma presents the following fluoroscopic findings: (1) Irregular filling defects in the outline of the stomach wall. (2) Abnormal peristalsis, there being no waves at the site of the filling defect; or, if the carcinoma involves the pylorus, antiperistaltic waves are seen. (3) Hourglass contraction where there is involvement of the middle portion of the stomach. The bismuth meal or water may be seen trickling through the narrowed lumen. (4) Adhesions of the stomach to adjacent organs, due to perigastric inflammation. (5) The lumen of the stomach is usually much smaller than normal, excepting, when the carcinoma involves the pylorus, we may have a dilatation.

III. GASTRIC ULCER. (1) Filling defects, which are not as irregular in outline as in carcinoma, the filling defect being due more to an irritation of the muscular action than to irregular outlines of mass changes in the stomach wall. This interference with the peristalsis in ulcers of the lesser or greater curvature is interesting. Where the ulcer involves the pylorus we have the additional symptoms previously noted when there is interference with the exit of the food.

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